

ρ(770)

$$I^G(J^{PC}) = 1^+(1^{- -})$$

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ρ(770) MASS

We no longer list S-wave Breit-Wigner fits, or data with high combinatorial background.

NEUTRAL ONLY, e⁺e⁻

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
775.49 ± 0.34 OUR AVERAGE				
775.97 ± 0.46 ± 0.70	900k	1 AKHMETSHIN 07		e ⁺ e ⁻ → π ⁺ π ⁻
774.6 ± 0.4 ± 0.5	800k	2,3 ACHASOV 06	SND	e ⁺ e ⁻ → π ⁺ π ⁻
775.65 ± 0.64 ± 0.50	114k	4,5 AKHMETSHIN 04	CMD2	e ⁺ e ⁻ → π ⁺ π ⁻
775.9 ± 0.5 ± 0.5	1.98M	6 ALOISIO 03	KLOE	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.8 ± 0.9 ± 2.0	500k	6 ACHASOV 02	SND	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.9 ± 1.1		7 BARKOV 85	OLYA	e ⁺ e ⁻ → π ⁺ π ⁻
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
775.8 ± 0.5 ± 0.3	1.98M	8 ALOISIO 03	KLOE	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.9 ± 0.6 ± 0.5	1.98M	9 ALOISIO 03	KLOE	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.0 ± 0.6 ± 1.1	500k	10 ACHASOV 02	SND	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.1 ± 0.7 ± 5.3		11 BENAYOUN 98	RVUE	e ⁺ e ⁻ → π ⁺ π ⁻ , μ ⁺ μ ⁻
770.5 ± 1.9 ± 5.1		12 GARDNER 98	RVUE	0.28–0.92 e ⁺ e ⁻ → π ⁺ π ⁻
764.1 ± 0.7		13 O'CONNELL 97	RVUE	e ⁺ e ⁻ → π ⁺ π ⁻
757.5 ± 1.5		14 BERNICHA 94	RVUE	e ⁺ e ⁻ → π ⁺ π ⁻
768 ± 1		15 GESHKEN... 89	RVUE	e ⁺ e ⁻ → π ⁺ π ⁻

CHARGED ONLY, τ DECAYS and e⁺e⁻

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
775.4 ± 0.4 OUR AVERAGE					
775.5 ± 0.7		16 SCHAEEL 05C	ALEP		τ ⁻ → π ⁻ π ⁰ ν _τ
775.5 ± 0.5 ± 0.4	1.98M	6 ALOISIO 03	KLOE		1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.1 ± 1.1 ± 0.5	87k	17,18 ANDERSON 00A	CLE2		τ ⁻ → π ⁻ π ⁰ ν _τ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
774.8 ± 0.6 ± 0.4	1.98M	9 ALOISIO 03	KLOE	-	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
776.3 ± 0.6 ± 0.7	1.98M	9 ALOISIO 03	KLOE	+	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
773.9 ± 2.0 ^{+0.3} _{-1.0}		19 SANZ-CILLERO03	RVUE		τ ⁻ → π ⁻ π ⁰ ν _τ
774.5 ± 0.7 ± 1.5	500k	6 ACHASOV 02	SND	±	1.02 e ⁺ e ⁻ → π ⁺ π ⁻ π ⁰
775.1 ± 0.5		20 PICH 01	RVUE		τ ⁻ → π ⁻ π ⁰ ν _τ

MIXED CHARGES, OTHER REACTIONS

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
763.0±0.3±1.2	600k	²¹ ABELE	99E	CBAR	0±	0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$

CHARGED ONLY, HADROPRODUCED

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
766.5±1.1 OUR AVERAGE						
763.7±3.2		ABELE	97	CBAR	$\bar{p}n \rightarrow \pi^-\pi^0\pi^0$	
768 ±9		AGUILAR-...	91	EHS	400 pp	
767 ±3	2935	²² CAPRARO	87	SPEC	-	200 $\pi^-\pi^0\text{Cu} \rightarrow \pi^-\pi^0\text{Cu}$
761 ±5	967	²² CAPRARO	87	SPEC	-	200 $\pi^-\pi^0\text{Pb} \rightarrow \pi^-\pi^0\text{Pb}$
771 ±4		HUSTON	86	SPEC	+	202 $\pi^+\pi^0\text{A} \rightarrow \pi^+\pi^0\text{A}$
766 ±7	6500	²³ BYERLY	73	OSPK	-	5 π^-p
766.8±1.5	9650	²⁴ PISUT	68	RVUE	-	1.7-3.2 $\pi^-p, t < 10$
767 ±6	900	²² EISNER	67	HBC	-	4.2 $\pi^-p, t < 10$

NEUTRAL ONLY, PHOTOPRODUCED

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
768.5± 1.1 OUR AVERAGE						
770 ± 2 ±1	79k	²⁵ BREITWEG	98B	ZEUS	0	50-100 γp
767.6± 2.7		BARTALUCCI	78	CNTR	0	$\gamma p \rightarrow e^+e^-p$
775 ± 5		GLADDING	73	CNTR	0	2.9-4.7 γp
767 ± 4	1930	BALLAM	72	HBC	0	2.8 γp
770 ± 4	2430	BALLAM	72	HBC	0	4.7 γp
765 ±10		ALVENSLEB...	70	CNTR	0	$\gamma\text{A}, t < 0.01$
767.7± 1.9	140k	BIGGS	70	CNTR	0	<4.1 $\gamma\text{C} \rightarrow \pi^+\pi^-\text{C}$
765 ± 5	4000	ASBURY	67B	CNTR	0	$\gamma + \text{Pb}$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
771 ± 2	79k	²⁶ BREITWEG	98B	ZEUS	0	50-100 γp

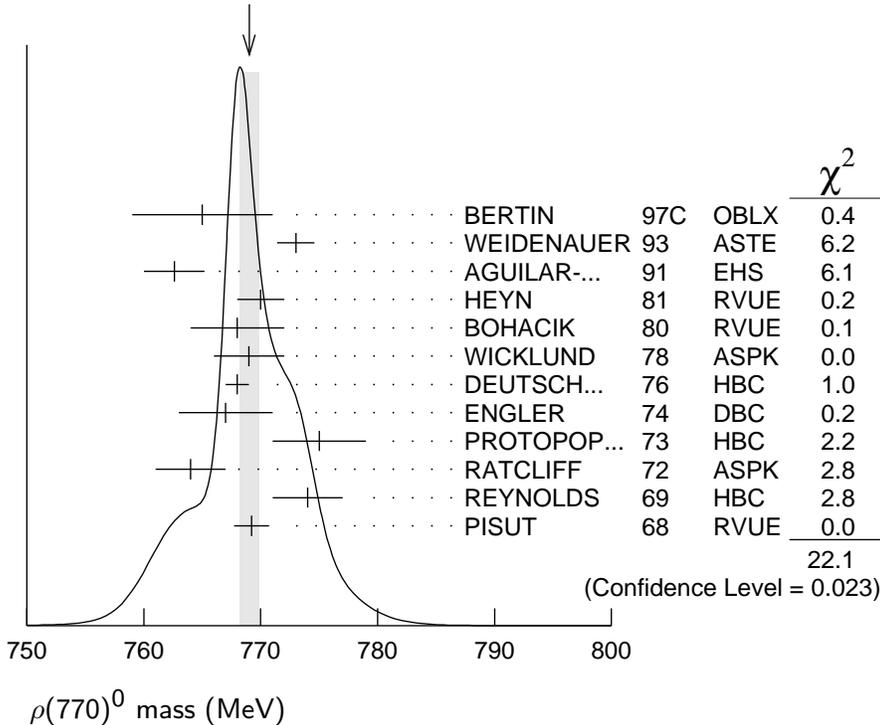
NEUTRAL ONLY, OTHER REACTIONS

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
769.0±0.9 OUR AVERAGE Error includes scale factor of 1.4. See the ideogram below.						
765 ±6		BERTIN	97C	OBLX		0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$
773 ±1.6		WEIDENAUER	93	ASTE		$\bar{p}p \rightarrow \pi^+\pi^-\omega$
762.6±2.6		AGUILAR-...	91	EHS		400 pp
770 ±2		²⁷ HEYN	81	RVUE		Pion form factor
768 ±4		^{28,29} BOHACIK	80	RVUE	0	
769 ±3		²³ WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm N$
768 ±1	76000	DEUTSCH...	76	HBC	0	16 π^+p
767 ±4	4100	ENGLER	74	DBC	0	6 $\pi^+n \rightarrow \pi^+\pi^-p$
775 ±4	32000	²⁸ PROTOPOP...	73	HBC	0	7.1 $\pi^+p, t < 0.4$
764 ±3	6800	RATCLIFF	72	ASPK	0	15 $\pi^-p, t < 0.3$
774 ±3	1700	REYNOLDS	69	HBC	0	2.26 π^-p
769.2±1.5	13300	³⁰ PISUT	68	RVUE	0	1.7-3.2 $\pi^-p, t < 10$

• • • We do not use the following data for averages, fits, limits, etc. • • •

773.5±2.5		31 COLANGELO	01	RVUE	$\pi\pi \rightarrow \pi\pi$
762.3±0.5±1.2	600k	32 ABELE	99E	CBAR 0	0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$
777 ±2	4943	33 ADAMS	97	E665	470 $\mu p \rightarrow \mu XB$
770 ±2		34 BOGOLYUB...	97	MIRA	32 $\bar{p}p \rightarrow \pi^+\pi^-\chi$
768 ±8		34 BOGOLYUB...	97	MIRA	32 $pp \rightarrow \pi^+\pi^-\chi$
761.1±2.9		DUBNICKA	89	RVUE	π form factor
777.4±2.0		35 CHABAUD	83	ASPK 0	17 $\pi^- p$ polarized
769.5±0.7		28,29 LANG	79	RVUE 0	
770 ±9		29 ESTABROOKS	74	RVUE 0	17 $\pi^- p \rightarrow \pi^+\pi^-n$
773.5±1.7	11200	22 JACOBS	72	HBC 0	2.8 $\pi^- p$
775 ±3	2250	HYAMS	68	OSPK 0	11.2 $\pi^- p$

WEIGHTED AVERAGE
769.0±0.9 (Error scaled by 1.4)



- 1 A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
- 2 Supersedes ACHASOV 05A.
- 3 A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.
- 4 Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.
- 5 Update of AKHMETSHIN 02.
- 6 Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.
- 7 From the GOUNARIS 68 parametrization of the pion form factor.
- 8 Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.
- 9 Without limitations on masses and widths.
- 10 Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0\pi\pi} = g_{\rho^\pm\pi\pi}$.
- 11 Using the data of BARKOV 85 in the hidden local symmetry model.

- 12 From the fit to $e^+e^- \rightarrow \pi^+\pi^-$ data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.
- 13 A fit of BARKOV 85 data assuming the direct $\omega\pi\pi$ coupling.
- 14 Applying the S-matrix formalism to the BARKOV 85 data.
- 15 Includes BARKOV 85 data. Model-dependent width definition.
- 16 From the GOUNARIS 68 parameterization of the pion form factor. The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.
- 17 $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.
- 18 From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.
- 19 Using the data of BARATE 97M and the effective chiral Lagrangian.
- 20 From a fit of the model-independent parameterization of the pion form factor to the data of BARATE 97M.
- 21 Assuming the equality of ρ^+ and ρ^- masses and widths.
- 22 Mass errors enlarged by us to Γ/\sqrt{N} ; see the note with the $K^*(892)$ mass.
- 23 Phase shift analysis. Systematic errors added corresponding to spread of different fits.
- 24 From fit of 3-parameter relativistic P -wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.
- 25 From the parametrization according to SOEDING 66.
- 26 From the parametrization according to ROSS 66.
- 27 HEYN 81 includes all spacelike and timelike F_π values until 1978.
- 28 From pole extrapolation.
- 29 From phase shift analysis of GRAYER 74 data.
- 30 Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDBERGER 64, ABOLINS 63.
- 31 Breit-Wigner mass from a phase-shift analysis of HYAMS 73 and PROTOPODESCU 73 data.
- 32 Using relativistic Breit-Wigner and taking into account ρ - ω interference.
- 33 Systematic errors not evaluated.
- 34 Systematic effects not studied.
- 35 From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P -wave intensity. CHABAUD 83 includes data of GRAYER 74.

$m_{\rho(770)^0} - m_{\rho(770)^\pm}$

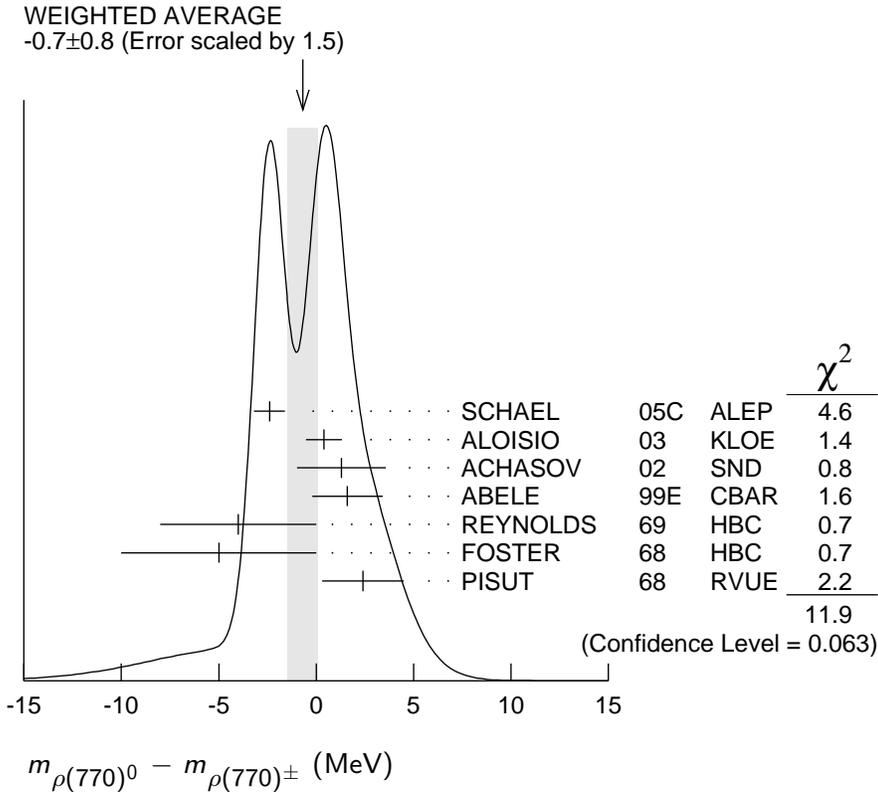
VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-0.7±0.8 OUR AVERAGE		Error includes scale factor of 1.5. See the ideogram below.			
-2.4±0.8		36 SCHAEL	05C	ALEP	$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$
0.4±0.7±0.6	1.98M	37 ALOISIO	03	KLOE	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
1.3±1.1±2.0	500k	37 ACHASOV	02	SND	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
1.6±0.6±1.7	600k	ABELE	99E	CBAR	$0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$
-4 ±4	3000	38 REYNOLDS	69	HBC	-0 $2.26 \pi^- p$
-5 ±5	3600	38 FOSTER	68	HBC	±0 $0.0 \bar{p} p$
2.4±2.1	22950	39 PISUT	68	RVUE	$\pi N \rightarrow \rho N$

³⁶ From the combined fit of the τ^- data from ANDERSON 00A and SCHAELE 05C and e^+e^- data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.

³⁷ Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

³⁸ From quoted masses of charged and neutral modes.

³⁹ Includes MALAMUD 69, ARMENISE 68, BATON 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65, CARMONY 64, GOLDBERGER 64, ABOLINS 63.



$m_{\rho(770)^+} - m_{\rho(770)^-}$

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
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● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

$1.5 \pm 0.8 \pm 0.7$	1.98M	⁴⁰ ALOISIO 03	KLOE	1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
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⁴⁰ Without limitations on masses and widths.

$\rho(770)$ RANGE PARAMETER

The range parameter R enters an energy-dependent correction to the width, of the form $(1 + q_r^2 R^2) / (1 + q^2 R^2)$, where q is the momentum of one of the pions in the $\pi\pi$ rest system. At resonance, $q = q_r$.

<u>VALUE (GeV⁻¹)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
5.3^{+0.9}_{-0.7}	CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized

$\rho(770)$ WIDTH

We no longer list S -wave Breit-Wigner fits, or data with high combinatorial background.

NEUTRAL ONLY, $e^+ e^-$

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
146.2 ± 0.7 OUR AVERAGE		Error includes scale factor of 1.1.			
145.98 ± 0.75 ± 0.50	900k	41 AKHMETSHIN 07			$e^+ e^- \rightarrow \pi^+ \pi^-$
146.1 ± 0.8 ± 1.5	800k	42,43 ACHASOV 06	SND		$e^+ e^- \rightarrow \pi^+ \pi^-$
143.85 ± 1.33 ± 0.80	114k	44,45 AKHMETSHIN 04	CMD2		$e^+ e^- \rightarrow \pi^+ \pi^-$
147.3 ± 1.5 ± 0.7	1.98M	46 ALOISIO 03	KLOE		$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
151.1 ± 2.6 ± 3.0	500k	46 ACHASOV 02	SND	0	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
150.5 ± 3.0		47 BARKOV 85	OLYA	0	$e^+ e^- \rightarrow \pi^+ \pi^-$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
143.9 ± 1.3 ± 1.1	1.98M	48 ALOISIO 03	KLOE		$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
147.4 ± 1.5 ± 0.7	1.98M	49 ALOISIO 03	KLOE		$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
149.8 ± 2.2 ± 2.0	500k	50 ACHASOV 02	SND		$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
147.9 ± 1.5 ± 7.5		51 BENAYOUN 98	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-, \mu^+ \mu^-$
153.5 ± 1.3 ± 4.6		52 GARDNER 98	RVUE		$0.28-0.92 e^+ e^- \rightarrow \pi^+ \pi^-$
145.0 ± 1.7		53 O'CONNELL 97	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$
142.5 ± 3.5		54 BERNICHA 94	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$
138 ± 1		55 GESHKEN... 89	RVUE		$e^+ e^- \rightarrow \pi^+ \pi^-$

CHARGED ONLY, τ DECAYS and $e^+ e^-$

<u>VALUE (MeV)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
149.4 ± 1.0 OUR FIT					
149.4 ± 1.0 OUR AVERAGE					
149.0 ± 1.2		56 SCHAEEL 05C	ALEP		$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$
149.9 ± 2.3 ± 2.0	500k	46 ACHASOV 02	SND	±	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
150.4 ± 1.4 ± 1.4	87k	57,58 ANDERSON 00A	CLE2		$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$143.7 \pm 1.3 \pm 1.2$	1.98M	⁴⁶ ALOISIO	03	KLOE	\pm	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
$142.9 \pm 1.3 \pm 1.4$	1.98M	⁴⁹ ALOISIO	03	KLOE	$-$	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
$144.7 \pm 1.4 \pm 1.2$	1.98M	⁴⁹ ALOISIO	03	KLOE	$+$	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$
$150.2 \pm 2.0^{+0.7}_{-1.6}$		⁵⁹ SANZ-CILLERO03		RVUE		$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$
$150.9 \pm 2.2 \pm 2.0$	500k	⁵⁰ ACHASOV	02	SND		$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$

MIXED CHARGES, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
149.5 ± 1.3	600k	⁶⁰ ABELE	99E	CBAR	$0 \pm 0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$

CHARGED ONLY, HADROPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
150.2 ± 2.4 OUR FIT					
150.2 ± 2.4 OUR AVERAGE					
152.8 ± 4.3		ABELE	97	CBAR	$\bar{p} n \rightarrow \pi^- \pi^0 \pi^0$
155 ± 11	2935	⁶¹ CAPRARO	87	SPEC	$200 \pi^- \text{Cu} \rightarrow \pi^- \pi^0 \text{Cu}$
154 ± 20	967	⁶¹ CAPRARO	87	SPEC	$200 \pi^- \text{Pb} \rightarrow \pi^- \pi^0 \text{Pb}$
150 ± 5		HUSTON	86	SPEC	$202 \pi^+ \text{A} \rightarrow \pi^+ \pi^0 \text{A}$
146 ± 12	6500	⁶² BYERLY	73	OSPK	$5 \pi^- p$
148.2 ± 4.1	9650	⁶³ PISUT	68	RVUE	$1.7-3.2 \pi^- p, t < 10$
146 ± 13	900	EISNER	67	HBC	$4.2 \pi^- p, t < 10$

NEUTRAL ONLY, PHOTOPRODUCED

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
150.7 ± 2.9 OUR AVERAGE					
$146 \pm 3 \pm 13$	79k	⁶⁴ BREITWEG	98B	ZEUS	$0 \ 50-100 \gamma p$
150.9 ± 3.0		BARTALUCCI	78	CNTR	$0 \ \gamma p \rightarrow e^+ e^- p$
• • • We do not use the following data for averages, fits, limits, etc. • • •					
138 ± 3	79k	⁶⁵ BREITWEG	98B	ZEUS	$0 \ 50-100 \gamma p$
147 ± 11		GLADDING	73	CNTR	$0 \ 2.9-4.7 \gamma p$
155 ± 12	2430	BALLAM	72	HBC	$0 \ 4.7 \gamma p$
145 ± 13	1930	BALLAM	72	HBC	$0 \ 2.8 \gamma p$
140 ± 5		ALVENSLEB...	70	CNTR	$0 \ \gamma \text{A}, t < 0.01$
146.1 ± 2.9	140k	BIGGS	70	CNTR	$0 \ < 4.1 \gamma \text{C} \rightarrow \pi^+ \pi^- \text{C}$
160 ± 10		LANZEROTTI	68	CNTR	$0 \ \gamma p$
130 ± 5	4000	ASBURY	67B	CNTR	$0 \ \gamma + \text{Pb}$

NEUTRAL ONLY, OTHER REACTIONS

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
150.9 ± 1.7 OUR AVERAGE					Error includes scale factor of 1.1.
122 ± 20		BERTIN	97C	OBLX	$0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$
145.7 ± 5.3		WEIDENAUER	93	ASTE	$\bar{p} p \rightarrow \pi^+ \pi^- \omega$
144.9 ± 3.7		DUBNICKA	89	RVUE	π form factor
148 ± 6	66,67	BOHACIK	80	RVUE	0

152 ± 9		⁶² WICKLUND	78	ASPK	0	3,4,6 $\pi^\pm p N$
154 ± 2	76000	DEUTSCH...	76	HBC	0	16 $\pi^+ p$
157 ± 8	6800	RATCLIFF	72	ASPK	0	15 $\pi^- p, t < 0.3$
143 ± 8	1700	REYNOLDS	69	HBC	0	2.26 $\pi^- p$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
147.0 ± 2.5	600k	⁶⁸ ABELE	99E	CBAR	0	0.0 $\bar{p} p \rightarrow \pi^+ \pi^- \pi^0$
146 ± 3	4943	⁶⁹ ADAMS	97	E665		470 $\mu p \rightarrow \mu X B$
160.0 ⁺ 4.1 - 4.0		⁷⁰ CHABAUD	83	ASPK	0	17 $\pi^- p$ polarized
155 ± 1		⁷¹ HEYN	81	RVUE	0	π form factor
148.0 ± 1.3		^{66,67} LANG	79	RVUE	0	
146 ± 14	4100	ENGLER	74	DBC	0	6 $\pi^+ n \rightarrow \pi^+ \pi^- p$
143 ± 13		⁶⁷ ESTABROOKS	74	RVUE	0	17 $\pi^- p \rightarrow \pi^+ \pi^- n$
160 ± 10	32000	⁶⁶ PROTOPOP...	73	HBC	0	7.1 $\pi^+ p, t < 0.4$
145 ± 12	2250	⁶¹ HYAMS	68	OSPK	0	11.2 $\pi^- p$
163 ± 15	13300	⁷² PISUT	68	RVUE	0	1.7–3.2 $\pi^- p, t < 10$

⁴¹ A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

⁴² Supersedes ACHASOV 05A.

⁴³ A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

⁴⁴ Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.

⁴⁵ From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

⁴⁶ Assuming $m_{\rho^+} = m_{\rho^-}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-}$.

⁴⁷ From the GOUNARIS 68 parametrization of the pion form factor.

⁴⁸ Assuming $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$, $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$.

⁴⁹ Without limitations on masses and widths.

⁵⁰ Assuming $m_{\rho^0} = m_{\rho^\pm}$, $g_{\rho^0 \pi \pi} = g_{\rho^\pm \pi \pi}$.

⁵¹ Using the data of BARKOV 85 in the hidden local symmetry model.

⁵² From the fit to $e^+ e^- \rightarrow \pi^+ \pi^-$ data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.

⁵³ A fit of BARKOV 85 data assuming the direct $\omega \pi \pi$ coupling.

⁵⁴ Applying the S-matrix formalism to the BARKOV 85 data.

⁵⁵ Includes BARKOV 85 data. Model-dependent width definition.

⁵⁶ From the GOUNARIS 68 parameterization of the pion form factor. The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.

⁵⁷ $\rho(1700)$ mass and width fixed at 1700 MeV and 235 MeV respectively.

⁵⁸ From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.

⁵⁹ Using the data of BARATE 97M and the effective chiral Lagrangian.

⁶⁰ Assuming the equality of ρ^+ and ρ^- masses and widths.

⁶¹ Width errors enlarged by us to $4\Gamma/\sqrt{N}$; see the note with the $K^*(892)$ mass.

⁶² Phase shift analysis. Systematic errors added corresponding to spread of different fits.

⁶³ From fit of 3-parameter relativistic P -wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.

⁶⁴ From the parametrization according to SOEDING 66.

⁶⁵ From the parametrization according to ROSS 66.

⁶⁶ From pole extrapolation.

⁶⁷ From phase shift analysis of GRAYER 74 data.

⁶⁸ Using relativistic Breit-Wigner and taking into account ρ - ω interference.

⁶⁹ Systematic errors not evaluated.

⁷⁰ From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P -wave intensity. CHABAUD 83 includes data of GRAYER 74.

⁷¹ HEYN 81 includes all spacelike and timelike F_π values until 1978.

⁷² Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDHABER 64, ABOLINS 63.

$\Gamma_{\rho(770)^0} - \Gamma_{\rho(770)^\pm}$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.3±1.3 OUR AVERAGE				Error includes scale factor of 1.4.
-0.2±1.0		⁷³ SCHAEL	05C ALEP	$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$
3.6±1.8±1.7	1.98M	⁴⁶ ALOISIO	03 KLOE	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$

⁷³ From the combined fit of the τ^- data from ANDERSON 00A and SCHAEL 05C and $e^+ e^-$ data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.

$\Gamma_{\rho(770)^+} - \Gamma_{\rho(770)^-}$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
1.8±2.0±0.5	1.98M	⁴⁹ ALOISIO	03 KLOE	$1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$

$\rho(770)$ DECAY MODES

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level
Γ_1 $\pi\pi$	~ 100	%
$\rho(770)^\pm$ decays		
Γ_2 $\pi^\pm \pi^0$	~ 100	%
Γ_3 $\pi^\pm \gamma$	$(4.5 \pm 0.5) \times 10^{-4}$	S=2.2
Γ_4 $\pi^\pm \eta$	< 6	$\times 10^{-3}$ CL=84%
Γ_5 $\pi^\pm \pi^+ \pi^- \pi^0$	< 2.0	$\times 10^{-3}$ CL=84%
$\rho(770)^0$ decays		
Γ_6 $\pi^+ \pi^-$	~ 100	%
Γ_7 $\pi^+ \pi^- \gamma$	$(9.9 \pm 1.6) \times 10^{-3}$	
Γ_8 $\pi^0 \gamma$	$(6.0 \pm 0.8) \times 10^{-4}$	
Γ_9 $\eta \gamma$	$(2.7 \pm 0.4) \times 10^{-4}$	S=1.8
Γ_{10} $\pi^0 \pi^0 \gamma$	$(4.5 \pm 0.8) \times 10^{-5}$	
Γ_{11} $\mu^+ \mu^-$	[a] $(4.55 \pm 0.28) \times 10^{-5}$	
Γ_{12} $e^+ e^-$	[a] $(4.71 \pm 0.05) \times 10^{-5}$	
Γ_{13} $\pi^+ \pi^- \pi^0$	$(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$	
Γ_{14} $\pi^+ \pi^- \pi^+ \pi^-$	$(1.8 \pm 0.9) \times 10^{-5}$	
Γ_{15} $\pi^+ \pi^- \pi^0 \pi^0$	< 4	$\times 10^{-5}$ CL=90%
Γ_{16} $\pi^0 e^+ e^-$		
Γ_{17} $\eta e^+ e^-$		

[a] The $\omega\rho$ interference is then due to $\omega\rho$ mixing only, and is expected to be small. If $e\mu$ universality holds, $\Gamma(\rho^0 \rightarrow \mu^+\mu^-) = \Gamma(\rho^0 \rightarrow e^+e^-) \times 0.99785$.

CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 10 measurements and one constraint to determine 3 parameters. The overall fit has a $\chi^2 = 10.7$ for 8 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

$$\begin{array}{c}
 x_3 \\
 \Gamma
 \end{array}
 \begin{array}{|c}
 -100 \\
 \hline
 15 \quad -15 \\
 \hline
 x_2 \quad x_3
 \end{array}$$

	Mode	Rate (MeV)	Scale factor
Γ_2	$\pi^\pm \pi^0$	150.2 ± 2.4	
Γ_3	$\pi^\pm \gamma$	0.068 ± 0.007	2.3

CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 7 branching ratios uses 19 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 9.1$ for 11 degrees of freedom.

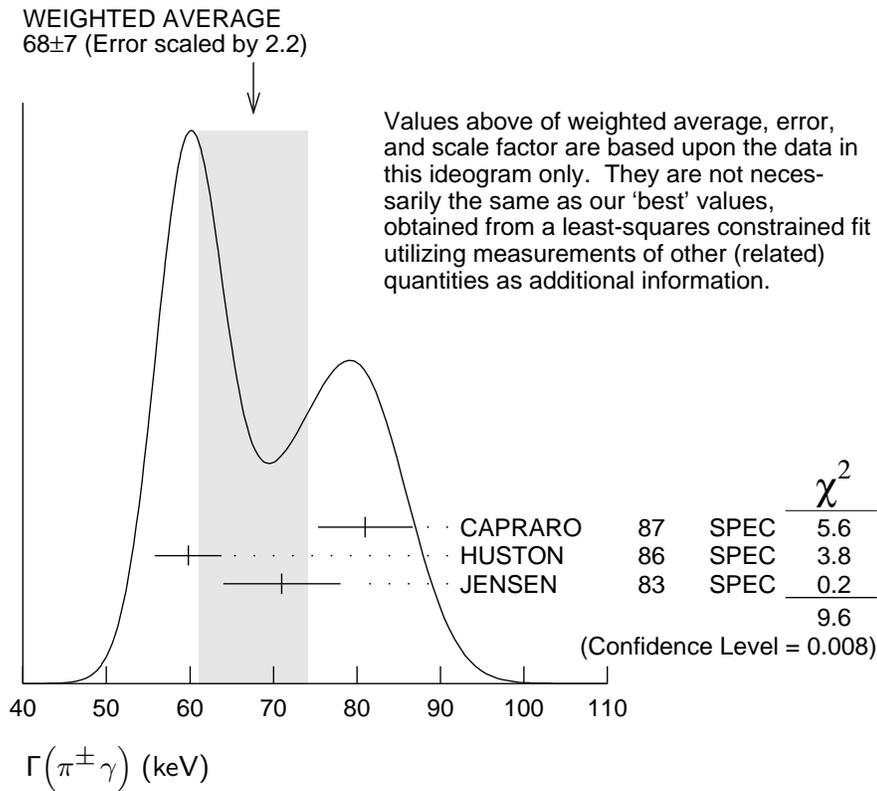
The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_7	-100							
x_8	-5	0						
x_9	-3	0	1					
x_{10}	-1	0	0	0				
x_{11}	2	-3	0	0	0			
x_{12}	1	0	-8	-7	0	0		
x_{14}	-1	0	0	0	0	0	0	
Γ	0	0	5	4	0	0	-59	0
	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{14}

Mode	Rate (MeV)	Scale factor
Γ_6 $\pi^+ \pi^-$	147.8 \pm 1.0	
Γ_7 $\pi^+ \pi^- \gamma$	1.48 \pm 0.24	
Γ_8 $\pi^0 \gamma$	0.090 \pm 0.012	
Γ_9 $\eta \gamma$	0.041 \pm 0.006	1.8
Γ_{10} $\pi^0 \pi^0 \gamma$	0.0067 \pm 0.0012	
Γ_{11} $\mu^+ \mu^-$	[a] 0.0068 \pm 0.0004	
Γ_{12} $e^+ e^-$	[a] 0.00704 \pm 0.00006	
Γ_{14} $\pi^+ \pi^- \pi^+ \pi^-$	0.0027 \pm 0.0014	

$\rho(770)$ PARTIAL WIDTHS

$\Gamma(\pi^\pm \gamma)$							Γ_3
VALUE (keV)		DOCUMENT ID	TECN	CHG	COMMENT		
68 \pm 7	OUR FIT	Error includes scale factor of 2.3.					
68 \pm 7	OUR AVERAGE	Error includes scale factor of 2.2. See the ideogram below.					
81 \pm 4 \pm 4		CAPRARO	87	SPEC	-	200 $\pi^- \pi^0 \text{A} \rightarrow \pi^- \pi^0 \text{A}$	
59.8 \pm 4.0		HUSTON	86	SPEC	+	202 $\pi^+ \pi^0 \text{A} \rightarrow \pi^+ \pi^0 \text{A}$	
71 \pm 7		JENSEN	83	SPEC	-	156-260 $\pi^- \pi^0 \text{A} \rightarrow \pi^- \pi^0 \text{A}$	



$\Gamma(e^+e^-)$

Γ_{12}

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
7.04 ±0.06 OUR FIT				
7.04 ±0.06 OUR AVERAGE				
7.048±0.057±0.050	900k	41 AKHMETSHIN 07		$e^+e^- \rightarrow \pi^+\pi^-$
7.06 ±0.11 ±0.05	114k	74,75 AKHMETSHIN 04	CMD2	$e^+e^- \rightarrow \pi^+\pi^-$
6.77 ±0.10 ±0.30		BARKOV 85	OLYA	$e^+e^- \rightarrow \pi^+\pi^-$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
7.12 ±0.02 ±0.11	800k	76 ACHASOV 06	SND	$e^+e^- \rightarrow \pi^+\pi^-$
6.3 ±0.1		77 BENAYOUN 98	RVUE	$e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$

$\Gamma(\pi^0\gamma)$

Γ_8

VALUE (keV)	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
77±17±11	36500	78 ACHASOV 03	SND	0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$
121±31		DOLINSKY 89	ND	$e^+e^- \rightarrow \pi^0\gamma$

$\Gamma(\eta\gamma)$

Γ_9

VALUE (keV)	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
62±17	79 DOLINSKY 89	ND	$e^+e^- \rightarrow \eta\gamma$

$\Gamma(\pi^+\pi^-\pi^+\pi^-)$

Γ_{14}

VALUE (keV) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.8±1.4±0.5 153 AKHMETSHIN 00 CMD2 0.6–0.97 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

⁷⁴ Using the GOUNARIS 68 parametrization with the complex phase of the ρ - ω interference.

⁷⁵ From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

⁷⁶ Supersedes ACHASOV 05A.

⁷⁷ Using the data of BARKOV 85 in the hidden local symmetry model.

⁷⁸ Using $\Gamma_{\text{total}} = 147.9 \pm 1.3$ MeV and $B(\rho \rightarrow \pi^0\gamma)$ from ACHASOV 03.

⁷⁹ Solution corresponding to constructive ω - ρ interference.

$\rho(770) \Gamma(e^+e^-)\Gamma(i)/\Gamma^2(\text{total})$

$\Gamma(e^+e^-) \times \Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}^2$ $\Gamma_{12}\Gamma_6/\Gamma^2$

VALUE (units 10⁻⁵) EVTS DOCUMENT ID TECN COMMENT

4.876±0.023±0.064 800k ^{80,81} ACHASOV 06 SND $e^+e^- \rightarrow \pi^+\pi^-$

⁸⁰ Supersedes ACHASOV 05A.

⁸¹ A fit of the SND data from 400 to 1000 MeV using parameters of the $\rho(1450)$ and $\rho(1700)$ from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

$\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ $\Gamma_{12}\Gamma_9/\Gamma^2$

VALUE (units 10⁻⁸) EVTS DOCUMENT ID TECN COMMENT

1.29±0.19 OUR FIT Error includes scale factor of 1.9.

1.26±0.17 OUR AVERAGE Error includes scale factor of 1.6. See the ideogram below.

1.12±0.12±0.02 33k ⁸² ACHASOV 06A SND $e^+e^- \rightarrow \eta\gamma$

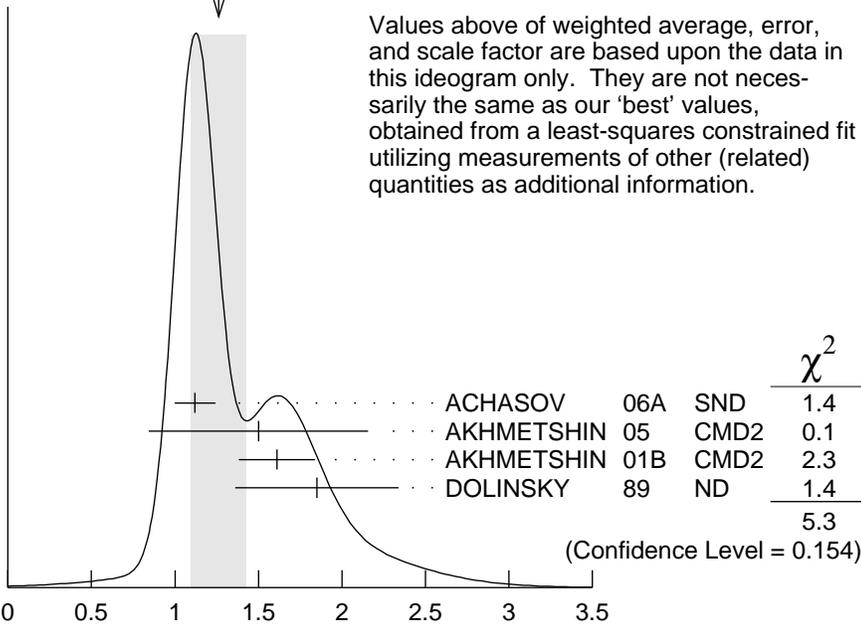
1.50±0.65±0.09 17.4k ⁸⁵ AKHMETSHIN 05 CMD2 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$

1.61±0.20±0.11 23k ^{86,87} AKHMETSHIN 01B CMD2 $e^+e^- \rightarrow \eta\gamma$

1.85±0.49 ⁸⁸ DOLINSKY 89 ND $e^+e^- \rightarrow \eta\gamma$

⁸² From a combined fit of $\sigma(e^+e^- \rightarrow \eta\gamma)$ with $\eta \rightarrow 3\pi^0$ and $\eta \rightarrow \pi^+\pi^-\pi^0$, and fixing $B(\eta \rightarrow 3\pi^0)/B(\eta \rightarrow \pi^+\pi^-\pi^0) = 1.44 \pm 0.04$. Supersedes ACHASOV 00D. Recalculated by us from the cross section at the peak.

WEIGHTED AVERAGE
 1.26 ± 0.17 (Error scaled by 1.6)



$$\Gamma(e^+e^-) \times \Gamma(\eta\gamma) / \Gamma_{\text{total}}^2 \quad \Gamma_{12}\Gamma_9 / \Gamma^2$$

$$\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma) / \Gamma_{\text{total}}^2 \quad \Gamma_{12}\Gamma_8 / \Gamma^2$$

VALUE (units 10^{-8})	EVTS	DOCUMENT ID	TECN	COMMENT
2.8 ± 0.4 OUR FIT				
2.8 ± 0.4 OUR AVERAGE				
$2.90^{+0.60}_{-0.55} \pm 0.18$	18680	AKHMETSHIN 05	CMD2	$0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$
$2.37 \pm 0.53 \pm 0.33$	36500	⁸³ ACHASOV 03	SND	$0.60-0.97 e^+e^- \rightarrow \pi^0\gamma$
$3.61 \pm 0.74 \pm 0.49$	10625	⁸⁸ DOLINSKY 89	ND	$e^+e^- \rightarrow \pi^0\gamma$

⁸³ Using $\sigma_{\phi \rightarrow \pi^0\gamma}$ from ACHASOV 00 and $m_\rho = 775.97$ MeV in the model with the energy-independent phase of ρ - ω interference equal to $(-10.2 \pm 7.0)^\circ$.

$$\Gamma(e^+e^-) \times \Gamma(\pi^+\pi^-\pi^0) / \Gamma_{\text{total}}^2 \quad \Gamma_{12}\Gamma_{13} / \Gamma^2$$

VALUE (units 10^{-9})	EVTS	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$4.58^{+2.46}_{-1.64} \pm 1.56$	1.2M	⁸⁴ ACHASOV 03D	RVUE	$0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$

⁸⁴ Statistical significance in less than 3σ .

⁸⁵ From the $\eta \rightarrow 2\gamma$ decay and using $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.

⁸⁶ From the $\eta \rightarrow 3\pi^0$ decay and using $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.

⁸⁷ The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).

⁸⁸ Recalculated by us from the cross section in the peak.

$\rho(770)$ BRANCHING RATIOS

$\Gamma(\pi^\pm \eta)/\Gamma(\pi\pi)$ Γ_4/Γ_1

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
<60	84	FERBEL	66	HBC	\pm $\pi^\pm p$ above 2.5

$\Gamma(\pi^\pm \pi^+ \pi^- \pi^0)/\Gamma(\pi\pi)$ Γ_5/Γ_1

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
<20	84	FERBEL	66	HBC	\pm $\pi^\pm p$ above 2.5

• • • We do not use the following data for averages, fits, limits, etc. • • •

35 ± 40	JAMES	66	HBC	+	2.1 $\pi^+ p$
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$\Gamma(\mu^+ \mu^-)/\Gamma(\pi^+ \pi^-)$ Γ_{11}/Γ_6

<u>VALUE (units 10^{-5})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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4.60 ± 0.28 OUR FIT

4.6 ± 0.2 ± 0.2	ANTIPOV	89	SIGM $\pi^- \text{Cu} \rightarrow \mu^+ \mu^- \pi^- \text{Cu}$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

8.2 $^{+1.6}_{-3.6}$	90 ROTHWELL	69	CNTR Photoproduction
5.6 ± 1.5	91 WEHMANN	69	OSPK 12 $\pi^- \text{C, Fe}$
9.7 $^{+3.1}_{-3.3}$	92 HYAMS	67	OSPK 11 $\pi^- \text{Li, H}$

$\Gamma(e^+ e^-)/\Gamma(\pi\pi)$ Γ_{12}/Γ_1

<u>VALUE (units 10^{-4})</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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• • • We do not use the following data for averages, fits, limits, etc. • • •

0.40 ± 0.05	93 BENAKSAS	72	OSPK $e^+ e^- \rightarrow \pi^+ \pi^-$
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$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$ Γ_9/Γ

<u>VALUE (units 10^{-4})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
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2.7 ± 0.4 OUR FIT Error includes scale factor of 1.8.

3.6 ± 0.9	94 ANDREWS	77	CNTR	0	6.7–10 γCu
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• • • We do not use the following data for averages, fits, limits, etc. • • •

2.40 ± 0.25 ± 0.07	33k	89 ACHASOV	06A	SND	$e^+ e^- \rightarrow \eta\gamma$
3.21 ± 1.39 ± 0.20	17.4k	95,96 AKHMETSHIN	05	CMD2	0.60–1.38 $e^+ e^- \rightarrow \eta\gamma$
3.39 ± 0.42 ± 0.23	94,97,98	AKHMETSHIN	01B	CMD2	$e^+ e^- \rightarrow \eta\gamma$
1.9 $^{+0.6}_{-0.8}$	99	BENAYOUN	96	RVUE	0.54–1.04 $e^+ e^- \rightarrow \eta\gamma$
4.0 ± 1.1	94,96	DOLINSKY	89	ND	$e^+ e^- \rightarrow \eta\gamma$

⁸⁹ Using $B(\rho \rightarrow e^+ e^-) = (4.67 \pm 0.09) \times 10^{-5}$.

$\Gamma(\pi^+ \pi^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ Γ_{14}/Γ

<u>VALUE (units 10^{-5})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
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1.8 ± 0.9 OUR FIT

1.8 ± 0.9 ± 0.3	153	AKHMETSHIN	00	CMD2	0.6–0.97 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^+ \pi^-$
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<20	90	KURDADZE	88	OLYA	$e^+ e^- \rightarrow \pi^+ \pi^- \pi^+ \pi^-$
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$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi)$ Γ_{14}/Γ_1

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
<15	90	ERBE	69	HBC	0 2.5–5.8 γp
<20		CHUNG	68	HBC	0 3.2,4.2 $\pi^- p$
<20	90	HUSON	68	HLBC	0 16.0 $\pi^- p$
<80		JAMES	66	HBC	0 2.1 $\pi^+ p$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{total}$ Γ_{13}/Γ

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
$1.01^{+0.54}_{-0.36} \pm 0.34$		1.2M	100 ACHASOV	03D RVUE	0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$
<1.2	90		VASSERMAN	88B ND	$e^+e^- \rightarrow \pi^+\pi^-\pi^0$

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ Γ_{13}/Γ_1

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
~ 0.01		BRAMON	86	RVUE	0 $J/\psi \rightarrow \omega\pi^0$
<0.01	84	101 ABRAMS	71	HBC	0 3.7 $\pi^+ p$

$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{total}$ Γ_{15}/Γ

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>
<0.4	90	AULCHENKO	87C	ND	0 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●					
<2	90	KURDADZE	86	OLYA	0 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$

$\Gamma(\pi^+\pi^-\gamma)/\Gamma_{total}$ Γ_7/Γ

<u>VALUE</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
0.0099±0.0016 OUR FIT				
0.0099±0.0016		102 DOLINSKY	91	ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
0.0111 ± 0.0014		103 VASSERMAN	88	ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$
<0.005	90	104 VASSERMAN	88	ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$

$\Gamma(\pi^0\gamma)/\Gamma_{total}$ Γ_8/Γ

<u>VALUE (units 10^{-4})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
$6.21^{+1.28}_{-1.18} \pm 0.39$	18680	105,106 AKHMETSHIN	05	CMD2 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$
$5.22 \pm 1.17 \pm 0.75$	36500	106,107 ACHASOV	03	SND 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$
6.8 ± 1.7		108 BENAYOUN	96	RVUE 0.54–1.04 $e^+e^- \rightarrow \pi^0\gamma$
7.9 ± 2.0		106 DOLINSKY	89	ND $e^+e^- \rightarrow \pi^0\gamma$

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$ Γ_{16}/Γ

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
<1.6	AKHMETSHIN 05A	CMD2	0.72-0.84 $e^+ e^-$

$\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$ Γ_{17}/Γ

VALUE (units 10^{-5})	DOCUMENT ID	TECN	COMMENT
<0.7	AKHMETSHIN 05A	CMD2	0.72-0.84 $e^+ e^-$

$\Gamma(\pi^0 \pi^0 \gamma)/\Gamma_{\text{total}}$ Γ_{10}/Γ

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	COMMENT
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4.5 ± 0.8 OUR FIT

4.5^{+0.9}_{-0.8} OUR AVERAGE

5.2^{+1.5}_{-1.3} ± 0.6 190 109 AKHMETSHIN 04B CMD2 0.6-0.97 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$

4.1^{+1.0}_{-0.9} ± 0.3 295 110 ACHASOV 02F SND 0.36-0.97 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.8^{+3.4}_{-1.8} ± 0.5 63 111 ACHASOV 00G SND $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$

- ⁹⁰ Possibly large ρ - ω interference leads us to increase the minus error.
- ⁹¹ Result contains $11 \pm 11\%$ correction using SU(3) for central value. The error on the correction takes account of possible ρ - ω interference and the upper limit agrees with the upper limit of $\omega \rightarrow \mu^+ \mu^-$ from this experiment.
- ⁹² HYAMS 67's mass resolution is 20 MeV. The ω region was excluded.
- ⁹³ The ρ' contribution is not taken into account.
- ⁹⁴ Solution corresponding to constructive ω - ρ interference.
- ⁹⁵ Using $B(\rho \rightarrow e^+ e^-) = (4.67 \pm 0.09) \times 10^{-5}$ and $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$.
- ⁹⁶ Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$.
- ⁹⁷ The combined fit from 600 to 1380 MeV taking into account $\rho(770)$, $\omega(782)$, $\phi(1020)$, and $\rho(1450)$ (mass and width fixed at 1450 MeV and 310 MeV respectively).
- ⁹⁸ Using $B(\rho \rightarrow e^+ e^-) = (4.75 \pm 0.10) \times 10^{-5}$ from AKHMETSHIN 02 and $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$.
- ⁹⁹ Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution. Constructive ρ - ω interference solution.
- ¹⁰⁰ Statistical significance is less than 3σ .
- ¹⁰¹ Model dependent, assumes $l = 1, 2, \text{ or } 3$ for the 3π system.
- ¹⁰² Bremsstrahlung from a decay pion and for photon energy above 50 MeV.
- ¹⁰³ Superseded by DOLINSKY 91.
- ¹⁰⁴ Structure radiation due to quark rearrangement in the decay.
- ¹⁰⁵ Using $B(\rho \rightarrow e^+ e^-) = (4.67 \pm 0.09) \times 10^{-5}$.
- ¹⁰⁶ Not independent of the corresponding $\Gamma(e^+ e^-) \times \Gamma(\pi^0 \gamma)/\Gamma_{\text{total}}^2$.
- ¹⁰⁷ Using $B(\rho \rightarrow e^+ e^-) = (4.54 \pm 0.10) \times 10^{-5}$.
- ¹⁰⁸ Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

- 109 This branching ratio includes the conventional VMD mechanism $\rho \rightarrow \omega\pi^0, \omega \rightarrow \pi^0\gamma$, and the new decay mode $\rho \rightarrow f_0(600)\gamma, f_0(600) \rightarrow \pi^0\pi^0$ with a branching ratio $(2.0^{+1.1}_{-0.9} \pm 0.3) \times 10^{-5}$ differing from zero by 2.0 standard deviations.
- 110 This branching ratio includes the conventional VMD mechanism $\rho \rightarrow \omega\pi^0, \omega \rightarrow \pi^0\gamma$ and the new decay mode $\rho \rightarrow f_0(600)\gamma, f_0(600) \rightarrow \pi^0\pi^0$ with a branching ratio $(1.9^{+0.9}_{-0.8} \pm 0.4) \times 10^{-5}$ differing from zero by 2.4 standard deviations. Supersedes ACHASOV 00G.
- 111 Superseded by ACHASOV 02F.

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